VOL. 104 NO. 2702 *Friday, 11 October 1946* PAGES 335-356

SCIENCE

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Published by the

American Association for the Advancement of Science

113th AAAS Meeting—Boston, 26-31 December 1946

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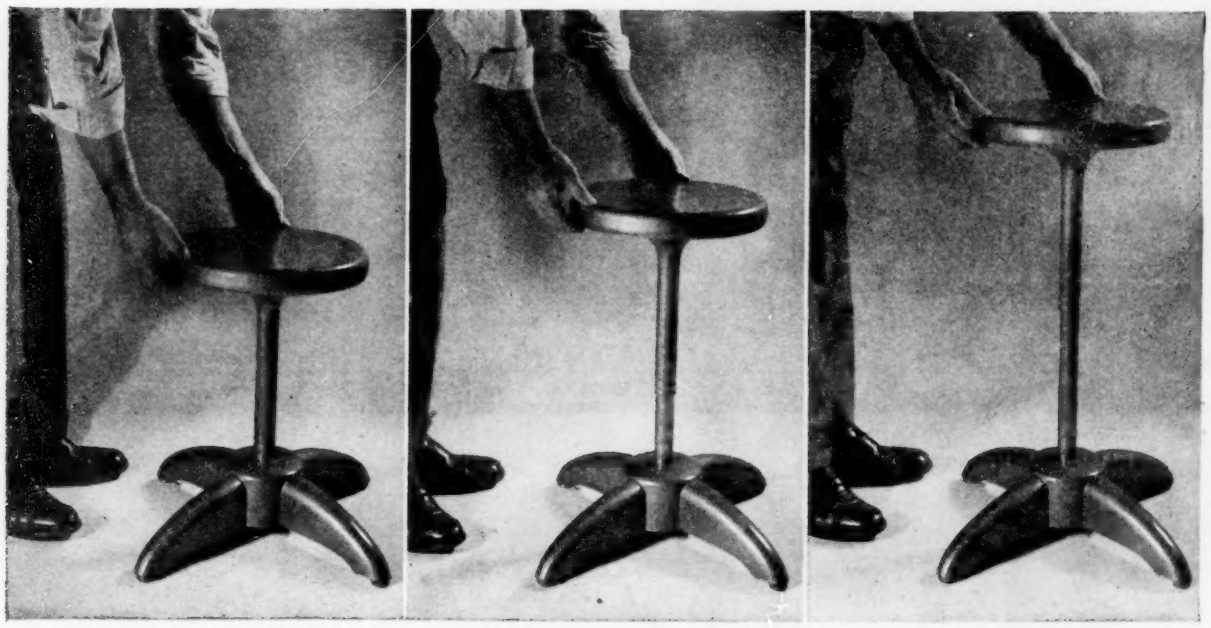

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SCIENCE

Vol. 104, No. 2702 Friday, 11 October 1946

The Cultural Understanding and Appreciation of the Scientific Approach

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REGARDLESS OF HOW SOON a National Science Foundation becomes a reality, the fact that support of scientific investigation by society as a whole, through its government, is being seriously considered is a significant development. It is doubtful whether such a proposal could have gained serious support before the war except among scientists.

If a democratic society is to continue to support scientific research, however, there must be an understanding of its place and an appreciation of its needs by leaders and representatives and ultimately by the population at large. Those who are to vote intelligently on how much of its resources society is to give to scientific work must have some understanding of how dependable knowledge is obtained, what it costs to establish reliable results, and how we are handicapped in achieving the kind of life we wish to achieve by the present limits of knowledge. The purpose of this paper is to provide some data indicating that such understanding may not be sufficiently widespread to insure continued support once the lessons of the war are in the process of being forgotten; and that, unless certain changes are made in the dissemination of scientific knowledge, such understanding may not develop rapidly. It will be shown that, because of the operation of various influences in the past, we would not expect a very intelligent lay attitude toward the scientific method.

An appreciation of the nature of research involves a conception of the general method by which scientific results are obtained, the nature of these results, and what is needed to establish dependable findings. One may know what has been discovered without knowing much about how the knowledge was obtained.

When we analyze the various dissemination activities of present-day science, it seems that they are concerned mainly with informing their audiences about the scientific findings that have been developed. The textbooks used in schools, the newspaper and magazine articles, and the motion picture and radio reports tend to center their emphasis on what is known. Three ideas seem to be characteristically absent. The first of these is the nature of the method by which the findings have been derived. There is little or almost no discussion of the peculiar characteristics of the scientific method or of the cost in human hopes and disappointments, as well as in money and other resources, by which these findings were developed. Consider, for example, the typical high school textbook in science. There may be short descriptions of the men who made scientific contributions and there may be names and dates; but there is little which helps the student to develop an appreciation of what it means to control the significant variables, the price that must be paid to apply this method, the difference between a good experiment and a poor one, or some of the difficulty man has experienced when he has tried to interpret and use the findings from studies in which the significant variables were not controlled. What is true of the typical high school textbook in science also tends to be true of other dissemination materials. As a result, we would expect that the vast majority of our population has grown up without even an elementary understanding of what the method really is and how long it takes to establish knowledge with a high degree of dependability.

The second omission that appears from our analysis of current dissemination activities is that of the probability character and especially the limits of knowledge. Scientific knowledge, as every investigator knows, exists in all degrees of refinement ranging from relationships that have been established with a high degree of probability (or a low probable error in the basic measurements) through less well-established generalizations to untested hypotheses. The degree of refinement determines the extent to which we can predict the probable result when knowledge is used in planning how to control the environment and ourselves. It determines the extent to which we can plan a course of action which will have the result we desire. For example, in the present state of knowledge there

appears to be some relationship in young children between diet and tooth decay. It also appears that factors other than diet are involved in the production of caries. But what these factors are is not definitely known. An important one may be fluorine. The details of the relationships are, however, not clear. If the parent wishes to produce good teeth in his child he cannot logically expect that careful control of diet will certainly assure that the child will have perfect teeth when he takes him for his first visit to the dentist. Neither can the dentist assume that, because the child has many imperfections or cavities, the parent has neglected dietary principles. The parent may have been neglectful, but before one can infer this from the condition of the child's teeth the probable errors of the data expressing the relation of frequency and extent of caries to the food eaten must be reduced considerably.

Furthermore, as every scientist knows, as long as scientific activity continues there is constant change in our knowledge. Hypotheses are subjected to test and changed into generalizations of known probability. More precise measuring instruments may be developed or more complete control of conditions may be achieved, with the result that generalizations having a relatively large probable error are replaced with generalizations having a small probable error, and so on.

These concepts of the fundamental nature of scientific knowledge and the peculiar growth characteristics are not included in the typical dissemination materials. As a result, we would expect that they are also not operative in the thinking of the community leaders and representatives who play such a large part in the democratic process. Only when an individual realizes the serious gaps, how we are handicapped by them, and what the results may be if these gaps are not filled, will he have some motivation for supporting further investigation. Without such motivation the attempts to obtain continued social support may not meet with success. But present-day dissemination tends to omit the consideration of the gaps and the resulting handicaps.

The above observations would lead us to the hypothesis that the activity we call research is not well understood by the ordinary lay leader and that it is not considered by him as a particularly important function to be supported by society.

We may extend our analysis further. If we consider that the vast majority of persons in their daily activities see and otherwise experience relatively unscientific approaches to problems, especially social problems, we would expect that they would not learn to look upon research as an important method for solving problems.

We have, then, several hypotheses which we can subject to test: (1) that the activity we call research is not well understood either by community leaders or by the students coming up through our schools; (2) that research is not considered as an important function in society; and (3) that scientific research is not looked upon as an important method of solving social problems.

Data relative to these three hypotheses will now be presented. These data will consist of two parts. The first concerns the results obtained when a group of 50 community leaders were interviewed. This study was carried out in the spring of 1946. The second set of data consists of the results obtained when high school juniors and seniors were studied as to their understanding of various aspects of scientific research.

In the interview with the 50 community leaders it was desired to obtain data on four major questions. The first was the meaning of research, *i.e.* the ideas which community leaders attached to this term. Secondly, we wanted to know how important the community leaders regarded research. To make this concrete, data were sought concerning the importance which they attached to research as an enterprise of a university in contrast with other functions that a university might perform in society. Then one problem, namely, child development, was selected, and two types of data were sought relative to it: the source of the most dependable, refined knowledge about child development in the thinking of community leaders, and whether research in child development is needed. Child development lends itself rather well for such an investigation, since it embraces both the natural and social sciences and at the same time is of rather widespread interest.

In the interview eight major questions were formulated and used as a guide. Each question was followed through until the interviewer was satisfied that he had explored the concept thoroughly. The data were gathered by trained persons who themselves were engaged in scientific investigation.

An example or two may serve to show how the interview was conducted. In attempting to obtain data concerning the importance attached to research as an enterprise of a university in contrast with other functions that a university might perform, three questions were asked:

Let us look at various parts of the university for a moment. You know that medicine is important for all persons, children as well as adults. You also know that at the college of medicine there are many professors on the university staff. How do you think these professors should spend their working day? What do you think they should do?

Now I want to ask you about the Child Welfare Research Station. (The interviews were made in an Iowa

community and this unit of the university was reasonably well known.) It is made up of several people. When you put them all together, they are interested in children of different ages, parents, orphans, etc. How do you think these people should spend their working day? What would you expect them to do?

Let us take another area of the university. Name an area with which you are most familiar, such as chemistry, botany, zoology, mathematics, physics, or any other. In this department (after subject had named a department), there are many professors. How would you expect them to spend their day? What would you expect them to do?

The answers to the three questions were combined and the results expressed on a seven-point scale ranging from "1—research is the prime function of a university" to "7—teaching is the principal function (with no mention of research)." Step 4 puts teaching and research about equal in importance.

In the group of 50 community leaders, which included the outstanding citizens in a midwest Iowa community of 15,000, the following distribution of scores relative to the importance of research was obtained:

Scale value	*"f"*
1	0
2	1
3	2
4	8
5	12
6	14
7	13

From this distribution it can be seen that 78 per cent rated teaching as more important than research, and 54 per cent hardly mentioned research or did not mention it at all as a function of a university.

Furthermore, the term research has relatively little meaning. On a seven-point scale on which Step 1 represents considering research as involving study through controlled variables and Step 7 represents practical inability to describe much of anything about the concept, the following distribution was obtained:

Scale value	*"f"*
1	1
2	3
3	22
4	2
5	.....
6	22
7	.....

Approximately half of the group were able to describe research as finding out new things or attempting to get new knowledge by study, but few (scale values 1 and 2) were able to suggest that the most dependable type of study is one in which known variables are controlled. For the other half of the group the term had little or no meaning beyond simple reading, study, or laboratory work without their being able to describe the nature of such work.

To determine what method these community leaders tend to rely on for the solution of a social problem, several questions were asked relative to the source of the best or most dependable knowledge about child development. On a seven-point scale on which Step 1 represents systematic research as the most dependable source and Step 7 represents statements by lay persons, such as teachers, parents, and the like, as the best source, the following distribution was obtained:

Scale value	*"f"*
1	0
2	5
3	3
4	6
5	10
6	4
7	22

It is quite clear that the proportion considering research as the most dependable source is extremely small, only 16 per cent being on the research side of the distribution (below scale value 4). These data support rather strongly the hypothesis that the level of development of the concepts relating to the nature and function of research is quite low.

A study of the growth of scientific concepts in high school juniors and seniors shows much the same picture as that for community leaders. The development at the high school level was studied by preparing tests consisting of problems requiring for their solution the application of the basic concepts with which we are here concerned. Problems were developed to test the ability to apply the idea that at any given moment scientific knowledge exists in different degrees of refinement, that the degree of refinement of the knowledge used in making a prediction sets the limits of the accuracy obtainable in the prediction, that knowledge grows by research and only by research, and that the function of research is to extend the boundaries of knowledge.

In constructing the test situations an effort was made to present simple, everyday problems so that the student would have no difficulty in understanding the situation and could make full use of whatever knowledge he possessed. For example, in testing the individual's conception of the nature and function of research, he was given three types of situations. In one he was given a series of five statements and asked to check the one that gave his idea of the principal function of research. In another he was asked to take some limited area of knowledge, such as the effect of different metals on the strength of alloy steel, the

effect of smoking upon physical growth, or the influence of "cold shots" in preventing colds, and to mention one fact about the area chosen that had been demonstrated to be true and one question that had not been investigated to any great extent. The subject was given a wide variety of areas from which to make his choice. In the third situation he was asked to give an example of a scientific investigation in any field which has been made within the last 10 or 20 years and to show what effect this investigation has had on our knowledge of the field. A method of scoring was carefully worked out and tested for reliability.

Several investigations of high school juniors and seniors have been made. These used a variety of testing situations and different samples, but the findings are strikingly similar. The results from the most recent investigation, a study of 176 students, reported by Fitzgerald and Ojemann (*Child Developm.*, 1944, **15**, 53–62), will be summarized here. In the following table the per cent of subjects in this study achieving 75 per cent or more of the total possible score on the various groups of items is presented:

Group	*Per cent*
Nature and function of research	18
Dependence of growth of knowledge on research	34
Awareness of the growth characteristic of knowledge	42
Knowledge of effect of error in basic data on error in prediction	7
Awareness of different degrees of refinement or probability characteristic of knowledge	29

In interpreting these data it is helpful to take into account that the per cent for each group is the proportion achieving three-fourths or more of the total possible score. Thus, if the subject was presented with four situations, he would have to solve three of them to be counted in the above tabulation. A score equal to 75 per cent of the total possible score seems a reasonable minimum, however, for if the subject understood the nature of the scientific approach, he would easily be able to achieve this minimum. From the above tabulation, it will be noted that only approximately 1 in 5 is aware of the nature and function of research; about 1 in 3, that knowledge grows by research; about 2 in 5, the simple fact that knowledge grows; about 1 in 14, that the degree of accuracy in prediction is limited by the error in the basic knowledge; and finally, 3 in 10, that knowledge exists in different degrees of refinement.

These data tend to indicate that not only are present-day adult community leaders far from understanding and appreciating the scientific approach, but we seem to be developing another generation with somewhat the same characteristics. It is also interesting to note that when studies were made of the relationship between such experiences as the number of semesters of mathematics or of science which the pupil had taken in his high school career, no significant relationship between these experiences and the development of these basic concepts could be found. One might think that mathematics would be a good area in which to point out the probability characteristic of knowledge and the effect that this characteristic has in the use of knowledge in planning future action. Similarly, one might expect that training in science should help the pupil to develop a conception of the nature and function of research and the dependence of growth of knowledge on research. In this group of 176 juniors and seniors the number of semesters of science varied from zero to seven, but the correlation between the number of semesters of science and scores on the tests of basic scientific concepts was .07, or practically zero. The number of semesters of mathematics varied from two to five, but no relationship between amount of mathematics and test scores was found.

Thus, it appears that, with present methods of educating and guiding youth and adults, the basic appreciation of the scientific approach is not especially well developed. This is not encouraging if we expect society to give increasing support to scientific endeavors. Fortunately, we are not restricted to present methods of developing youth. We can change those methods.

In a pilot study using high school students, Musgrove (*Univ. Ia. Stud. Child Welf.*, 1939, **17**, 115–128) was able to bring about a significant increase in the understanding and appreciation of the scientific approach. To conduct the study, however, it was necessary for her to prepare her own reading and teaching materials, since the kinds of materials needed were not available. This gives some indication of what will have to be done to bring about a higher level of development throughout society. If all of the various dissemination media, including textbooks, newspaper and magazine features, motion picture reports, and radio presentations will give more attention to the basic concepts involved, the job may be done before the lessons of the war recede too far in popular thinking. That such a change is needed seems to be indicated by the data presented. How soon the change can be made remains the challenge.

Obituary

Boris Aleksandrovich Keller
1874-1945

Academician Boris Aleksandrovich Keller, one of he most outstanding Russian plant ecologists, director f the Moscow Botanical Gardens of the Academy of ciences, and president of the Turkmen Branch of he same Academy, died in Moscow on 25 October 1945.

B. A. Keller was born on 28 August 1874 in St. etersburg but spent his childhood in the Volga re- ion, mostly in Volsk and Saratov. He was educated Moscow and Kazan Universities and after his grad- ation in 1902 became assistant in botany at Kazan niversity and docent in 1910.

This period of his life was devoted to the geobotan- al research of the Central and Lower Volga regions, sulting in several publications, the most important which is *Semi-desert regions* (1907), written in col- boration with a soil scientist, N. Dimo. In this work gave one of the best classifications of the Russian eppes and made use of his method of "ecological eries" in the study of plant associations in connection ith their environment; he introduced also a new con- pt of "semiarid regions" and was first to make an ologophysiological study of the vegetation of the eppes, deserts, and semideserts.

In 1906 he took part in the expedition of the Im- igration Department to the Semipalatinsk region d later published an extensive two-volume work, *otanico-geographical explorations of the Zaisan gion of the Semipalatinsk Province* (1912). In 1909 d 1910 he explored the Altai region, incorporating e results of this expedition in another large work, *the valleys and mountains of the Altai* (1914).

His reputation as a botanist and explorer now tablished, he was appointed professor of botany at oronezh Agricultural Institute in 1913, which posi- on he held for almost 18 years. During this period founded an agricultural experiment station and eated a highly efficient school of Russian agrono- ists, thus contributing greatly to the development of riculture in his country. Although his schedule was avy, he was able to publish some excellent books on e vegetation of the Lower Volga region, including *the problem of the classification of the Russian eppes* (1916), in which he gave a masterful analysis the types of steppe-vegetation, and the two-volume *egetative world of the Russian steppes, semi-deserts d deserts* (1923–26). He also edited a large collec- ve work, *Steppes of the Central Chernozem region* 1931). In all these works Keller made an all-round udy of the vegetation, emphasizing its ecological as- pect. His classification of the steppes differs from others in that it is based chiefly on botanical characteristics and not on the properties of substrata. He established the actual types of the steppe vegetation and explained the general laws of the distribution of plants throughout the world.

It was only logical that finally he turned to the study of ecological morphology and physiology of xerophytes and halophytes, especially their water regime. In his research on the relation of plant to drought and salification, as, for instance, his "Vegetation of the saline soils of the U.S.S.R." (1940) and other papers, he revealed the physiological nature of this adaptation and gave the picture of the evolution of these ecological forms.

Being an ardent and convinced adept in Darwin's theory of evolution, he applied his methods to his own studies. But in all his works he considered the problem of evolution as an ecologophysiological one and tried to explain many aspects of it on the basis of the way in which plants obtain nourishment and their relation to the environment. This is a new approach to the problem of evolution, because other students of evolution usually applied the morphological method, and Keller supplemented his theoretical studies by experimental work on the living plants in the Moscow Botanical Garden.

In 1931 Keller was elected a member of the Academy of Sciences and of the Lenin Agricultural Academy. In the same year he was appointed director of the Institute of Botany of the Academy of Sciences, one of the most important positions in the botanical field in the Soviet Union, and director of the Soil Institute. In 1936 he was in charge of an agricultural expedition into the Altai region and later edited a large collective work, *Agriculture of the mining region of the Altai* (1940). In 1937 he was given his last assignment—the reorganization of the Botanical Gardens of the Academy of Sciences at Moscow, where he tried to put in practice his ideas on ecology and evolution of plants.

By his death Russia lost one of its most distinguished botanists and a pioneer in the study of plant communities whose constant aim was to combine theoretical studies with the practical and economic needs of his country. Russian agriculture owes him as much as botany, for he not only created a school of Russian agronomists but also published many papers on various problems of agricultural research.

VLADIMIR C. ASMOUS
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Technical Papers

An Iron-binding Component in Human Blood Plasma

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Following the demonstration of a protein component in raw egg white capable of binding iron (*5*), we investigated fractions of human plasma for a similar property.

Through the courtesy and interest of E. J. Cohn, L. E. Strong, and their associates we obtained representative samples of plasma fractions prepared by them (*2*).[1] Fraction I (fibrinogen), Fraction II-1 (γ-globulin), Fraction II + III (prothrombin, immune globulins, isohemagglutinins, Rh antibodies, carotenoids, and phosphatides associated with globulins), Fraction IV-1 (lipids apparently associated with β-globulins), Fraction IV-3,4 (rich in α- and β-globulins), and Fraction V (albumin), after addition to nutrient broth in a concentration approximately equal to that found in whole plasma, were tested for their ability to inhibit growth of *Shigella dysenteriae*. Of these fractions, only II + III and IV-3,4 were clearly active. The tubes containing Fraction V showed slightly delayed growth. When excess ferrous iron was added to the inhibited cultures, only those tubes with Fraction IV-3,4 showed bacterial development after an additional 18-hour incubation. Qualitative tests for the formation of a typical salmon pink color (*5*) upon addition of ferrous iron to solutions of Fractions II + III and IV-3,4 indicated that only Fraction IV-3,4 was active in this respect. Hence, qualitatively, Fraction IV-3,4, as shown by the biological and colorimetric tests, is similar to the active egg white component as regards affinity for and reaction with iron.

When ferrous iron as ferrous ammonium sulfate was added to Fraction IV-3,4 in 0.02 M phosphate buffer at pH 6.5, it was found by colorimetry that 1 mg. of protein [N × 7.13 (*4*)] took up a maximum of 0.44 γ Fe^{++}. In the biological test in which graded amounts of iron were added to inoculated nutrient broth cultures of *S. dysenteriae* to observe at what iron level growth took place, the results showed that 1 mg. of protein made 0.38 γ Fe^{++} unavailable for bacterial development. Other samples of Fraction IV-3,4 and a subfraction, IV-3, gave similar results although the ratio of milligrams of protein to gamma of iron bound varied from the example given.

Since our work with partially fractionated egg white gave us material whose activity approached that of mg. of protein for 1 γ Fe^{++}, we sought to raise the activity of Fraction IV-3,4 by further fractionation. For this purpose samples of the fraction were dialyzed against several changes of distilled water until a pre-

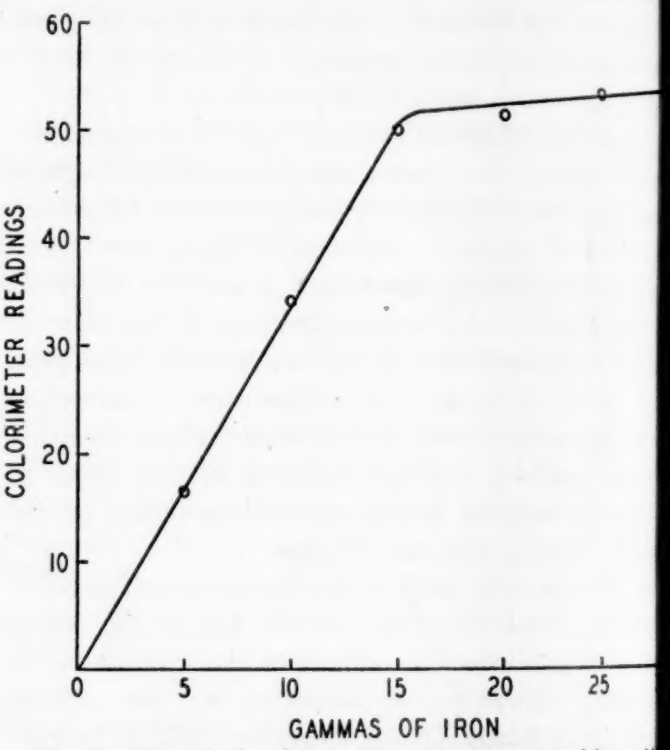

FIG. 1. The relationship between the amount of iron added to human plasma Fraction IV-3,4 and color production. Five cc. of the soluble portion of the dialyzed Fraction IV-3,4, adjusted to pH 6.4 with $NaHCO_3$ and containing 25.6 mg. of protein, were set at zero in a Klett-Summerson colorimeter with the blue filter #42. Additions of 5 γ Fe^{++} in 0.1-cc. amounts were made to the sample. Four minutes after each addition, readings were made of the increase in depth of the characteristic salmon pink color.

cipitate had formed which, on analysis, represented approximately one-third of the nondialyzable nitrogen. To test the precipitate for its capacity to form a colored product with added iron, it was first suspended in 0.25 per cent saline solution and finally dissolved through alkalinization with sodium carbonate. The resultant opalescent solution was then neutralized with hydrochloric acid and mixed with graded amounts of iron. No color whatever developed, even when the ratio was as great as 1 mg. of protein to 1.5 γ of iron. Contrariwise, when the nonprecipitated fraction was tested colorimetrically with added iron, it was found that saturation of the active protein component occurred when 0.66 γ Fe^{++} was added to 1.0 mg. protein of the sample. Fig. 1 illustrates this result.

[1] The products of plasma fractionation employed in this work were developed by the Department of Physical Chemistry, Harvard Medical School, under a contract recommended by the Committee on Medical Research between the Office of Scientific Research and Development and Harvard University.

When the soluble dialyzed fraction was tested biologically, the results showed that approximately 0.57 γ of iron were made unavailable for the growth of *S. dysenteriae* by 1 mg. of the protein in nutrient broth. Since the soluble nitrogen represented approximately two-thirds of the total nitrogen of the dialyzed sample, it should be noted that the activity of this fraction in terms of iron-binding power was proportionately greater and accounted for all of the activity shown by the undialyzed fraction, IV-3,4.

The presence in human plasma of a protein fraction having the capacity to bind iron at physiological pH's may have some relevance to the problem of the regulation of iron absorption from the intestinal mucosa as well as that of iron transport by the blood through the body (*3*).[2] In this connection it is of some interest to note that for a medium-sized man of 70-kg. weight it is calculated that, through the intervention alone of the amount of active fraction in plasma when saturated with iron, as much as 9 mg. of iron (0.26 mg./100 cc. plasma) could be carried by the blood stream at any given moment. Analyses of iron content of normal plasma have given values of 0.1–0.3 mg./100 cc. under ordinary conditions (*1*). Of no less importance is the possible significance of this iron-binding fraction in the blood stream for the bacteriostatic action it exerts upon iron-sensitive pathogens as shown by the *in vitro* studies with *S. dysenteriae*. What value an iron-saturated solution of this plasma fraction may have for iron administration in certain anemias remains to be demonstrated.

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Origin of Nitrogen in Natural Gases

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About three years ago W. B. Lang (*3*) discussed the occurrence of nitrogen in natural gases and suggested that the probable source of the element could be established by analyzing suitable samples for nitrogen and the rare gases, argon, krypton, xenon, and neon. If the relative proportions of nitrogen and argon in a particular gas sample were found to be substantially the same as in air, one might reasonably conclude that the nitrogen and argon had originally been present in the atmosphere and had in some way become trapped within the earth. On the other hand, an abundance ratio of nitrogen to argon much higher than that for air might mean that the nitrogen in the gas had been produced within the earth by chemical reactions.

Similar deductions from gas analyses have been made in the past by others, and significant contributions to the literature about this topic have been made (*1, 4–9*). The interpretation of the data has not always been exactly the same as that of Lang. For example, Moureu was of the opinion that the substantially fixed relative proportions of nitrogen, argon, krypton, and xenon which he and A. Lepape (*5*) found in the atmosphere and in gases from within the earth could be explained by the hypothesis that these inert elements had not been separated from each other by natural processes and were therefore present in all terrestrial gases in the proportions established at the time of creation.

TABLE 1

Proportions by Volume of Nitrogen and Helium Group Gases in Certain Natural Gases

Sample No.	% by volume of N_2	% by volume of He	$\frac{N_2/A \text{ in gas}}{N_2/A \text{ in air}}$	$\frac{(Kr+Xe)/A \text{ in gas}}{(Kr+Xe)/A \text{ in air}}$
I	72.9	7.55	0.98	0.4
II	52.6	6.00	1.19	0.8
III	24.7	1.73	1.50	3.0
IV	96.8	0.047	4.0	2.9
V	30.6	0.19	3.0	3.0
VI	10.0	0.052	3.3	3.7
VII	28.0	0.55	2.4	3.0
IX	97.0	0.074	1.25	..
X	24.1	0.305	8.2	0.15

A few analyses of the type proposed by Lang (*3*) were made as a part of a study recently published by the author and his father, H. P. Cady (*2*). In this work the helium group gases and nitrogen were determined in a few natural gases of high nitrogen content. Data for the different samples are presented in Table 1. The sample numbers used are the same as those employed in the earlier publication (*2*), where one may find detailed descriptions of the gases.

The wide variation in the (krypton + xenon)/argon ratios shown in the table suggests that the rare gases have become partially separated from each other by natural processes. It is therefore possible that argon and nitrogen have also become separated from each other and consequently occur in different proportions in different gases. Since this is the case and since there is no assurance that the inert elements in natural gas originally came from the atmosphere rather than from within the earth, one cannot use the available

[2] Since the time this manuscript was submitted, an article by Holmberg and Laurell (*Acta Physiol. Scand.* (Sweden), 1945, **10**, 307–319) concerning the regulation mechanism of serum iron has become available. This article refers to a thesis by Vahlquist (*Das Serumeisen* (Diss.). Uppsala: 1941), whose data suggested that serum iron is bound to both the albumin and, especially, the globulin protein fractions.

analytical data as a basis for unquestionable conclusions regarding the origin of the nitrogen.

The suggestion of Lang (*3*) involves the assumption that the argon of a natural gas is derived from the atmosphere and that argon and nitrogen are not substantially separated from each other as the gas collects. If such an assumption is correct, it follows that nitrogen in natural gases originates both in the atmosphere and in chemical processes. In some gases, such as Samples IV, V, VI, and X, most of the nitrogen appears to be of chemical origin and in others, such as Samples I, II, III, and IX, of atmospheric origin.

The U. S. Bureau of Mines and the Phillips Petroleum Company supplied most of the gas samples analyzed during this study. Their assistance is gratefully acknowledged.

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The Intestinal Absorption of Penicillin G

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Investigators are in general agreement that the oral dosage requirements of penicillin are four or five times the parenteral requirements in order to obtain comparable serum concentrations and equal therapeutic effectiveness (*2, 3, 5*). It has also been shown by Free, Parker, and Biro (*3*) and others that this approximate oral/parenteral ratio is substantiated by measurements of total urinary excretion of penicillin after administration by the two routes. Destruction by gastric acidity was found to account for only a minor portion of the loss of an oral dose.

In a survey of the problem Cutting, *et al.* (*1*) suggested that lack of intestinal absorption and subsequent destruction in the bowel by penicillinases may be of importance. The present work is an effort to obtain more specific information on the absorbability of penicillin from the intestine in order to evaluate this view.

Forty-four healthy adult mongrel cats, fasted for 24 hours previous to the experiments, were used for the study. Pure crystalline sodium penicillin G was used in order to make the results more referable. Under dial-urethane anesthesia (.7 cc./kg. dial with urethane, Ciba) .1 millimole penicillin/kg. body weight was placed in the ligated duodenum, the abdominal incision sutured, and absorption allowed to take place for various periods of time up to 3 hours. The penicillin had been dissolved previously in 2.5 cc. normal saline solution/kg. of cat in order to standardize intestinal fluid volumes and osmotic influences. At the end of the test period the incision was reopened, the duodenum removed, and the contents thoroughly washed out and analyzed for penicillin by the cylinder-plate method. Preliminary experiments showed that the duodenal contents of 24-hour fasted cats under dial-urethane anesthesia contained no substances interfering with the penicillin assay and that the duodenal contents alone gave no ring of inhibition with the test organism. Control recoveries of penicillin from injected loops removed and washed out immediately averaged 98 per cent of the injected quantity.

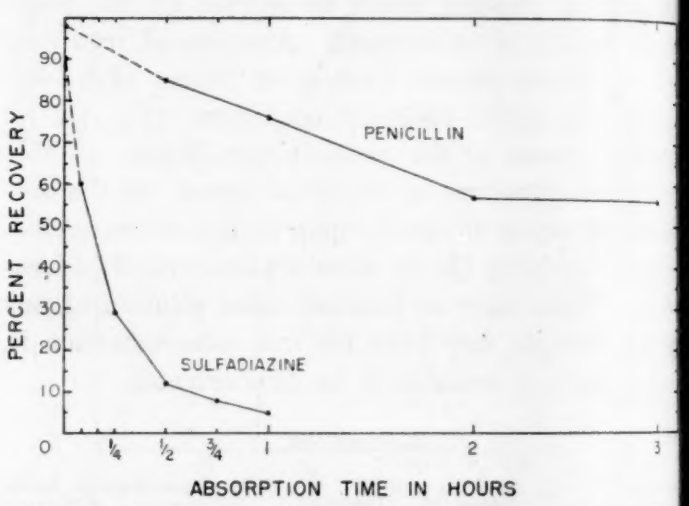

Fig. 1. Recoveries of sodium penicillin G and sodium sulfadiazine from the ligated duodenum of cats after various periods of absorption. Each point represents the average of four experiments.

As a comparison, the absorption of sulfadiazine, a chemotherapeutic agent known to be satisfactorily absorbed from the gastrointestinal tract, was studied under the same conditions. The dose used was .1 millimole sodium sulfadiazine/kg., and the administration, absorption, and recovery procedures were also the same as those used for the penicillin experiments. Sulfadiazine determinations were made by the colorimetric method of Marshall and Litchfield (*6*). Preliminary experiments showed that the duodenal contents of 24-hour fasted cats under dial-urethane anesthesia contained no substances interfering with the colorimetric assay for sulfadiazine. Control recoveries of sulfadiazine from injected loops removed and washed out immediately averaged 90 per cent of the injected quantity. Results are shown in Fig. 1.

The high recovery of penicillin from the ligated duodenum (an average of 76 per cent after 1 hour, 57 per

[1] With the technical assistance of Mary L. Wickert.

cent after 2 hours, and 56 per cent after 3 hours) indicates a definitely slow rate of absorption as compared to sulfadiazine absorption, in which case an average of only 12 per cent was recovered after ½ hour and 5 per cent after 1 hour of absorption. It therefore becomes increasingly evident that the major portion of an oral dose of penicillin passes through the upper portion of the intestinal tract unabsorbed. When it reaches the lower portions of the tract, where bacteria are more numerous and inactivating enzymes more likely to be present, destruction occurs before complete absorption can take place. Work to be published later confirms the assumption of a progressive rate of penicillin destruction downward in the gastrointestinal tract.

The slow absorption of penicillin from the intestine can be added to evidence of its passage with difficulty through certain other body membranes (*4*).

Efforts to increase the efficiency of oral administration should be directed toward increasing its penetration through the intestinal mucosa.

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Toxicity of DDT Isomers to Some Insects Affecting Man[1]

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Isolation of o,o′-DDT [1-trichloro-2,2-bis(o-chlorophenyl)ethane] from technical DDT by a method involving preferential dehydrochlorination with ethanolic sodium hydroxide of the more reactive p,p′-DDT [1-trichloro-2,2-bis(p-chlorophenyl)ethane] and o,p′-DDT [1-trichloro-2-o-chlorophenyl-2-p-chlorophenylethane] and oxidation of the resulting olefins with chromic anhydride, leaving the unreactive o,o′-DDT isomer, has recently been reported (*2*). Isolation of the other two isomers, p,p′-DDT, the major and most active constituent of technical DDT, and o,p′-DDT, the major impurity, has previously been reported (*4*).

As there has been considerable interest and speculation on the possible insecticidal activity of the o,o′-DDT isomer, we wish to present data as to the action of the substance against the fourth-instar larvae and adults of the common malaria mosquito (*Anopheles quadrimaculatus* Say) in America and against the housefly (*Musca domestica* L.) and the body louse (*Pediculus humanus corporis* Deg.). For comparison, results on the p,p′ and o,p′ isomers are also included. The compounds used had the following melting points: o,o′-DDT, 92–93° (cor.) (*2*); p,p′-DDT, 108.5–109.0° (cor.) (*4*); o,p′-DDT, 74.0–74.5° (cor.) (*4*).

The tests against the mosquito larvae were carried out by the beaker method in acetone-water suspension (*3*). Tests were made in triplicate, 20 insects being used in each test. Results are given in Table 1.

TABLE 1

Toxicity of DDT Isomers to Fourth-Instar Larvae of *A. quadrimaculatus*

DDT isomer	Dosage (ppm)	48-hr. mortality (%)
o,o′	5.0	17
	7.5	100
p,p′	0.00125	7
	.0025	32
	.005	74
	.01	100
o,p′	0.005	6
	.01	16
	.03	85

Spray tests were made against adult houseflies and mosquitoes. One ml. of a 1-per cent solution of each of the isomers in refined kerosene (Deobase) was sprayed into a 100-cubic-foot chamber in which the insects were exposed in small screen-wire cages and tested by a pendulum-swinging method. The tests were conducted in triplicate. Approximately 300 insects were used in each test. Results are given in Table 2.

TABLE 2

Toxicity of DDT Isomers to Adult Houseflies and *A. quadrimaculatus*

DDT isomer	Houseflies			Mosquitoes		
	Knockdown in 10 min. (%)	Knockdown in 30 min. (%)	Kill in 24 hr. (%)	Knockdown in 10 min. (%)	Knockdown in 30 min. (%)	Kill in 24 hr. (%)
o,o′	0	0	1	5	6	15
p,p′	0	14	50	20	69	89
o,p′	0	0	0	6	8	20

In tests against body lice by the beaker test method (*1*), o,o′-DDT and o,p′-DDT gave no kill at 0.2 per cent, whereas p,p′-DDT gave 100 per cent mortality at this concentration.

As compared with p,p′-DDT, the o,o′-DDT isomer was found to be of a very low order of toxicity against the adult and fourth-instar larvae of the common

[1] This research was conducted under a program supported by transfers of funds from the Office of the Quartermaster General and the Office of the Surgeon General of the U. S. Army to the Bureau of Entomology and Plant Quarantine.

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malaria mosquito and the adult housefly and body louse. Although o,p′-DDT was ineffective against adult mosquitoes, houseflies, and body lice, it was found to be a fairly effective anopheline larvicide.

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Blood Sugar Level Following Intravenous Glucose in Rheumatoid Arthritis

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It has been observed (*3*) and many times confirmed that patients with rheumatoid arthritis show a slower return of the blood sugar level to the fasting figure following the oral administration of glucose than do normal subjects. This has been variously considered as the result of (a) faulty intestinal absorption; (b) disturbances of pancreatic function (*2*); (c) circulatory abnormalities (*4*); and (d) dysfunction (*1, 6*).

To evaluate the role of gastrointestinal dysfunction and/or intestinal circulatory alterations, Soskin's intravenous glucose tolerance test (*5*)[2] was done on 64 patients with rheumatoid arthritis and 60 subjects with no evidence of organic disease. All patients with rheumatoid arthritis had multiple peripheral joint involvement and sedimentation rates (Wintrobe method) above 25 mm./hour.

In rheumatoid arthritis the blood sugar levels of 8 of the patients (12.5 per cent) had returned to the preinjection or fasting level within 60 minutes; in 42 patients (65.6 per cent) the blood sugar values fell to the preinjection level in between 60 and 120 minutes; and in 14 patients (21.9 per cent) the blood sugar levels at the end of 120 minutes were still higher than the preinjection figures. In the normal cases the blood sugar levels of 43 subjects (71.7 per cent) had returned to the preinjection level within 60 minutes; in 16 subjects (26.7 per cent) the blood sugar levels returned to the preinjection levels in between 60 and 120 minutes; and in 1 subject (1.6 per cent) the blood sugar was still elevated at the end of 120 minutes.

In Soskin's report (*5*) the blood sugar level of all of the normal controls (30 in number) returned to the preinjection figure within 60 minutes after the intravenous administration of the glucose. The fact that somewhat more than 25 per cent of the authors' normal controls failed to return within 60 minutes is not explainable on the basis of the numerical difference between the two groups. Soskin also found that in 25 cases of hepatic disease the blood sugar invariably returned to the preinjection level in between 60 and 120 minutes following the intravenous administration of the glucose. All but one of the authors' controls that failed to return in 60 minutes did so in 120 minutes. According to Soskin's data this would indicate that these subjects had hepatic disease. It is unlikely that such an assumption is correct, since approximately 50 per cent of the authors' normal controls showing an "hepatic curve" were officers and enlisted men on full military duty. The lack of agreement between the figures obtained by Soskin and those found by the authors in no way detracts from the present study, however, since the intravenous glucose tolerance was used primarily to evaluate the role of intestinal dysfunction. The striking difference between the results obtained by the intravenous glucose tolerance test in rheumatoid arthritis and those obtained in the normal controls is demonstrated in Fig. 1, which shows the

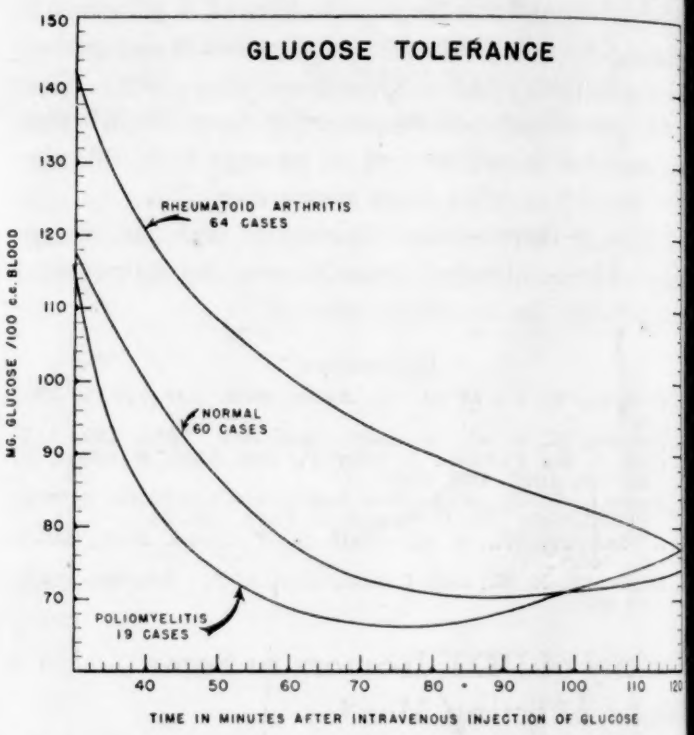

Fig. 1. Curves showing fall of the blood sugar level in the rheumatoid, normal control, and poliomyelitis groups. The curves of the three groups begin at the 30-minute postinjection level rather than the fasting level, since in all determinations the latter was arbitrarily adjusted to a level of 74 mg./100 cc.

[1] Presently located at Columbia University, New York City, and Veterans Administration, Washington, D. C., respectively.

[2] Method: One-third gram of dextrose/kg. body weight in a 50-per cent aqueous solution injected intravenously within a period of 3–5 minutes. A preinjection fasting and 30-, 60-, and 120-minute postinjection venous blood samples were assayed by the Somogyi method for the determination of the true blood sugar level.

mean curves of the glucose tolerance tests obtained after arbitrarily adjusting all figures to a preinjection blood sugar level of 74 mg./100 cc. This adjustment is permissible since, as Soskin (*5*) has pointed out, the important factor is the time interval required for the return of the blood sugar level to the preinjection figure, rather than the maximum height of the blood sugar level. This observation is confirmed by analysis of the data presented in Table 1. These figures were obtained by determining the blood sugar levels at 3 and 5 minutes after the intravenous injection of glucose in addition to the usual 30-, 60-, and 120-minute samples.

TABLE 1

Type of case	No. of cases	Mean postinjection blood sugar levels mg./100 cc.				
		3 min.	5 min.	30 min.	60 min.	120 min.
Rheumatoid arthritis	10	247.6	210.4	142.1	100.4	75.9
Normal controls	7	245.0	202.5	121.5	84.7	75.1

For these determinations an additional 10 patients with rheumatoid arthritis and 7 normal subjects were used. All fasting levels were again arbitrarily adjusted to 74 mg./100 cc. Three minutes after the injection of glucose was completed the blood sugar level was approximately the same for both types of cases. After 5 minutes the curves of the rheumatoid arthritic patients and the normal subjects became divergent, the normals falling faster than the rheumatoids. These deceleration studies indicate that the abnormal glucose tolerance in rheumatoid arthritis is not a simple function of the maximum height of the blood sugar level at the end of the glucose administration.

In view of the fact that the intravenous glucose tolerance test shows a slower deceleration of the blood level in 87.5 per cent of patients with rheumatoid arthritis than in 71.7 per cent of normal controls, it can be concluded that intestinal dysfunction plays no role in the altered glucose tolerance found in the former.

In a further effort to ascertain the factor or factors responsible for the difference in glucose tolerance between patients with rheumatoid arthritis and subjects with no evidence of organic disease, the aforementioned data were reconsidered in the light of the possible fate of intravenously injected glucose. This may presumably be disposed of via the following channels: (a) utilization in the tissues for immediate energy requirements, (b) conversion into hepatic glycogen or (c) into muscle glycogen, and (d) excretion in the urine.

To evaluate the possibility of the altered glucose tolerance resulting from a difference in the amount of glucose lost in the urine, quantitative urinary glucose determinations were made on the 64 rheumatoid arthritic cases and on the 60 normal controls. The urine samples were collected at approximately the time the blood samples were drawn for the glucose tolerance test. Most of the glucose lost in the two groups was present in the sample obtained 30 minutes after the glucose was administered, and samples obtained 2 hours after the injection of glucose were invariably free of sugar. The total output of urine for both groups was approximately the same for the interval during which the determinations were done. The difference in the 2-hour mean total urinary output of glucose of the rheumatoid (.516) and normal control (.600) groups amounted to only .084 grams/100 cc. of urine—obviously an amount too small to be of any significance.

To evaluate the possibility that the altered glucose tolerance in rheumatoid arthritis results from a diminution of peripheral glycogen depots consequent to muscle atrophy, the intravenous glucose tolerance test was also done on 19 patients with severe poliomyelitis, all of whom were convalescent. Only patients having severe atrophy of at least three extremities were used. Certain of the patients had a quadriplegia. Fig. 1 shows that the glucose tolerance curve for the poliomyelitis cases falls below both the normal and rheumatoid groups. The reason for the difference between the normal controls and poliomyelitis cases is not apparent. It is obvious, however, that diminution of peripheral glycogen depots does not explain the alteration of the glucose tolerance found in rheumatoid arthritis, since the poliomyelitis patients had as much and often more atrophy than the former group.

As before stated, pancreatic insufficiency has been suggested to explain the altered glucose tolerance. Soskin (*5*) demonstrated that when a constant and unvarying amount of insulin is supplied intravenously to a depancreatized dog, the administration of a large dose of glucose is still followed by a normal glucose tolerance curve. On the basis of this experiment and others equally ingenious (*5*), he demonstrated the existence of an hepatic homeostatic control which supplies glucose to the blood stream when the blood sugar level drops below a certain point and inhibits its release when it rises above a certain point. The homeostatic equilibrium is affected by certain endocrine glands, notably the pancreas, anterior lobe of the hypophysis, the thyroid, and the adrenal cortex. Hence, hormonal influences affecting the hepatic homeostatic control of the blood sugar level could account for the alteration in the glucose tolerance. The available data do not, however, permit evaluation of the role of these extrahepatic factors.

Summary

Since the majority of patients with rheumatoid arthritis show a slower fall in the blood sugar level after the intravenous injection of glucose than do the normal controls, the alteration cannot be explained on the basis of gastrointestinal dysfunction.

Differences in the renal threshold of glucose do not explain the altered glucose tolerance, since approximately the same amount of glucose is lost in the urine in both groups.

Blood samples taken at 3 and 5 minutes following the injection of the glucose showed the height of the blood sugar level to be approximately the same in the patients with rheumatoid arthritis and in normals. The slower fall in the blood sugar level of the former is therefore not a simple function of a greater rise following the intravenous administration of the glucose.

Although the patients with severe poliomyelitis had as much or more atrophy than the rheumatoid arthritic patients, there was no delay in rate of fall of the blood sugar level after the intravenous administration of glucose.

In view of the fact that the hepatic homeostatic control regulates the blood sugar level, faulty utilization of glucose by extrahepatic tissues cannot be considered the primary factor responsible for the alteration of the glucose tolerance.

The altered glucose tolerance in rheumatoid arthritis is explainable on the basis of an altered threshold of the hepatic homeostatic control of the blood sugar. Additional studies must be done to determine whether this derangement emanates directly from extrahepatic influences.

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News and Notes

About People

George A. Ellinger and *Harold E. Cleaves* have been appointed chiefs of the Optical Metallurgy Section and the Chemical Metallurgy Section, respectively, at the National Bureau of Standards.

Justin M. Andrews was recently commissioned as senior scientist (R) with the U. S. Public Health Service. He has assumed the position as deputy officer in charge of the Communicable Disease Center, Atlanta, Georgia. During the war, Dr. Andrews served as a colonel in the Sanitary Corps, AUS.

Carl A. Kuether, Western Reserve University, has recently been made professor of biochemistry at the new School of Medicine, University of Washington, Seattle.

Norman Kharasch, formerly of Northwestern University, has been appointed assistant professor of chemistry at the University of Southern California.

E. M. Gilbert, professor of botany at the University of Wisconsin, has retired after 36 years of service.

Julius A. Brown, director of the observatory at the American University at Beirut, Syria, from 1909 to 1945, has been named visiting lecturer in physics and astronomy at Colgate University.

Russell B. Stevens, recently on the staff of the Biology Department, University of Louisville, has become associate professor of botany, Alabama Polytechnic Institute, Auburn, Alabama.

Chalmer L. Cooper, formerly geologist with the Illinois State Geological Survey, has been appointed senior geologist with the U. S. Geological Survey, Washington, D. C., where he is working in the office of the director, coordinating activities of the various branches in the preparation of Survey reports for publication.

George M. Reed, since 1921 curator of plant pathology at the Brooklyn Botanic Garden, became curator emeritus on 1 October.

Roy O. Greep, Harvard School of Dental Medicine, Boston, has been appointed associate professor of dental science. The appointment became effective on 15 July.

Paul B. Beeson and *Albert Haymen,* Emory University, have received a grant of $12,500 from the U. S. Public Health Service for fundamental research in the mechanics and effects of fever.

Stanley A. Cain, professor of botany, University of Tennessee, will join the staff of Cranbrook Institute of Science, Bloomfield Hills, Michigan, on 15 October.

Stanley R. Ames, formerly associated with the Department of Biochemistry, University of Wisconsin, has joined the staff of the Biochemistry Department, Research Laboratories, Distillation Products, Inc., Rochester, New York, as an enzymologist.

Evarts A. Graham, head of the Department of Surgery, Washington University School of Medicine, St. Louis, will represent surgery at the centennial of the use of ether as an anesthetic by Morton, to be celebrated at Massachusetts General Hospital and the Harvard Medical School on 14–16 October. Among the speakers will be: Raymond Fosdick, president of the Rockefeller Foundation; Henry K. Beecher, professor of anesthesia at Harvard; and Karl T. Compton, president of Massachusetts Institute of Technology.

Owen B. Weeks, former research associate at the Franz Theodore Stone Laboratory, Put-in-Bay, Ohio, has been appointed associate professor of bacteriology at North Dakota Agricultural College, Fargo, North Dakota.

John Deal, associate professor of entomology at Pennsylvania State College, has recently been appointed adviser to the Minister of Agriculture and Forestry, Republic of China. Dr. Deal has already arrived in Nanking.

Elso S. Barghoorn, formerly assistant professor of biology at Amherst College, and field service consultant with the OSRD during the war, has been appointed assistant professor of botany at Harvard University.

Theodore A. Werkenthin, principal materials engineer (civilian) in charge of the Rubber and Plastics Section, Bureau of Ships, Navy Department, has received the Meritorious Civilian Service Award for his World War II work in connection with research and technological problems in the fields of natural rubber, synthetic rubber, and plastic elastomers.

John B. Washko, associate professor and associate agronomist at the University of Tennessee, has been appointed to a similar position at Pennsylvania State College.

M. Rocha e Silva, director of the Pharmacological Laboratory, Instituto Biologico of São Paulo, Brazil, has been visiting Chicago medical institutions on his way to the University of London, where he will spend a year as a British Council Fellow.

Frederick Betz, Jr., formerly of the U. S. Geological Survey, has been appointed assistant professor of geology at Lehigh University, Bethlehem, Pennsylvania.

W. F. Hewitt, Jr., has resigned as chairman of the Department of Physiology, College of Osteopathic Physicians and Surgeons, Los Angeles, and has joined the staff of the Research Department of Smith, Kline & French Laboratories, Philadelphia.

Gordon B. Mainland, assistant professor of biology, Illinois Institute of Technology, became visiting assistant professor of zoology at the University of Hawaii beginning on 1 September.

Arthur W. Melton has been appointed professor of psychology at The Ohio State University. Dr. Melton, formerly head of the Department of Psychology at the University of Missouri, served during the war as chief of the Department of Psychology, School of Aviation Medicine, Randolph Field, Texas.

Edward P. Claus has returned to the School of Pharmacy, University of Pittsburgh, as professor of pharmacognosy. During the past year he has been associated with the College of Pharmacy and the Allergy Unit, College of Medicine, University of Illinois.

E. V. Cowdry, head of the Department of Anatomy, Washington University School of Medicine, St. Louis, has been appointed a member of the Board of Directors of the American Cancer Society, the American Association of Cancer Research, and the National Cancer Foundation.

L. W. R. Jackson has been appointed professor of silviculture in the George Peabody School of Forestry, University of Georgia. Dr. Jackson, whose appointment became effective on 1 September, will teach the undergraduate and graduate courses in silviculture and direct graduate work in forestry. His own research will be devoted to a study of the forest floor and particularly of mycorrhizae.

Clarence F. Hiskey, former laboratory director for the 43rd Army Chemical Laboratory Company in Hawaii, has joined the staff of the Department of Chemistry, Polytechnic Institute of Brooklyn. He will teach courses in analytical chemistry and develop a program of fundamental research in this field.

Fred F. Flanders, chief chemist in charge of the Massachusetts Purchasing Bureau Laboratory, retired in September after serving in the Laboratory for 24 years.

George H. Schneller recently joined the Research Laboratories of The Wm. S. Merrell Company as chief of the Pharmaceutical Division.

M. L. Thompson has joined the staff of the Department of Geology, University of Wisconsin. Prof. Thompson was formerly on the staff of the Department of Geology, University of Kansas, was a member of the staff of the Kansas Geological Survey, and has

been a consultant for oil companies operating in the Gulf Coastal Plain and Rocky Mountain states. In addition to instructing in petroleum geology he will be in charge of instruction in invertebrate paleontology and micropaleontology.

Frank M. Semans, consulting entomologist and formerly head of the Biology Department, Youngstown College, has been appointed associate professor of biology at Hiram College, Hiram, Ohio.

Wojciech Swietoslawski, consulting fellow at the Mellon Institute, gave a farewell lecture at the Stephen Foster Memorial, Pittsburgh, on 9 October. His subject was "Phase Rule and Gravity." Dr. Swietoslawski, who had been Minister of Education in the Polish Cabinet before the invasion of Poland, came to the United States in 1939 to become a visiting professor of chemistry at the University of Pittsburgh. He will return to Poland on 24 October, as he considers it the duty of Polish scientists to replace those lost in the war.

K. K. Kimura has been named Roche Fellow in Pharmacology and Therapeutics at the University of Illinois College of Medicine for the academic year 1946–47. This fellowship has been endowed for a two-year period by the Roche Anniversary Foundation, Nutley, New Jersey, to provide better and more extensive graduate training in pharmacology.

Dorothy Wolff, Lempert Institute of Otology, New York City, was the guest lecturer of the otorhinolaryngologists of three countries in South America during the month of August. She lectured in Rio de Janeiro, Buenos Aires, Santiago, and Valparaiso on the histopathology of the ear.

M. E. Fine, F. J. Schnettler, and *P. P. R. Debye* have become members of the technical staff of the Chemical Laboratories, Bell Telephone Laboratories, Murray Hill, New Jersey. Dr. Fine and Mr. Schnettler were formerly with the Manhattan District Project at Los Alamos, New Mexico.

Announcements

The old house in Craven Street, London, which was the home of Benjamin Franklin between 1757 and 1775 has been occupied by the British Society for International Understanding. Through official cooperation, the Society is now engaged in restoring the house as nearly as possible to its original condition. It suffered some superficial damage during the war but the basic structure and panelling remain intact.

The Society is making an appeal for funds to complete restoration of the house and will accept gifts or loans of suitable furniture and pictures as well as contributions. Of special interest to the Society, and to United States readers, is the need for prints or engravings of Benjamin Franklin or of Philadelphia of colonial times which the owners might care to lend or donate. Donors are requested to correspond with either Lord Clarendon, Treasurer, or Mr. G. M. Young, Chairman, British Society for International Understanding, 36 Craven Street, London, W.C. 2.

The sixth annual search for science talent among a million high school seniors of the United States began the last week in September, according to Watson Davis, director of Science Clubs of America, which conducts the competition. Announcements of the sixth contest with entry blanks and full information are being sent to principals of 27,000 public, private, and denominational secondary schools.

It is expected that 3,500 students will complete the qualifying requirements. From these, 40 finalists will be selected. Next March these young scientists will attend a five-day Science Talent Institute in Washington, D. C., and compete for top honors in the Search. Two four-year Westinghouse Science Grand Scholarships of $2,400 each will be awarded to the outstanding boy and girl, and eight four-year Westinghouse Science Scholarships of $400 each will be awarded during the Institute after final tests and interviews by the Board of Judges. An additional $3,000 in scholarships may be granted at the discretion of the Judges.

Since the Search was inaugurated in 1942, 15,000 high school seniors, about one-fourth of them girls, have completed entry requirements. Fifteen hundred have been given recognition as "potential scientists," with the top 200 of them, 147 boys and 53 girls, being awarded $55,000 in scholarships from the Westinghouse Foundation, sponsor of the Talent Search. Of these, 106 are currently enrolled in 57 colleges and universities, many of them already on a graduate level. The scholarships of the 73 in military service are being held for them pending their discharge.

A special fall exhibit of common local weeds is on display until 31 October in the auditorium of the Chicago Academy of Sciences in Lincoln Park. The exhibit, which consists of about 200 of the most common local weeds, grouped by families, was selected and arranged by Anna Pederson Kummer from her unusually complete and attractive collection of mounted weed specimens. Mrs. Kummer is honorary curator of botany at the Academy and a teacher of botany at Waller High School.

The appointment of 111 civilian medical consultants has increased the number serving under the Secretary of War through The Surgeon General to 200, according to a recent announcement by the War Department. Of the 111 new appointments, 62 are surgeons, 29 are physicians, and 20 are neuropsychiatrists.

The Woman's Medical College of Pennsylvania opened its 97th session on 11 September at the Mary Dern Goodrich Auditorium at the College. Louise Pearce, associate member of the Rockefeller Foundation and president of the College, made the principal address on this occasion. There are 47 students in the new first-year class, and the total enrollment for the current college session is 152.

The Pacific Science Conference, called by the National Research Council from 6–8 June in Washington, was attended by 91 American scientists. Six came from Honolulu, 12 from the West Coast, and the entire group represented over 50 different universities, museums, and research institutions in various parts of the country. The Conference was also attended by some 75 liaison members who were appointed representatives from government departments and agencies concerned with Pacific matters. There were also official representatives from certain other American research councils.

During the opening session of the three-day Conference the official representatives of the State, War, Navy, Interior, Agriculture, and Commerce Departments and other government agencies stated their interest in the Pacific and the extent of their probable participation in future scientific activities in that area.

The conference then was divided into six divisional groups to discuss proposals in the following fields: the anthropological sciences, the earth sciences, oceanography and meteorology, the plant sciences, public health and medicine, and the zoological sciences. As a result of these divisional meetings specific recommendations were made for a program of future research.

At one session of the entire Conference general recommendations with regard to such matters as the establishment of scientific field stations at strategic points, the use of specially equipped vessels in oceanographic research, the declassification of scientific wartime reports, and the study of hidden natural resources of the sea, especially fish, were unanimously adopted. There were also recommendations pertaining to international cooperation, including such subjects as collaboration with the United Nations, the preparation of regional floras, the rehabilitation of war-devastated scientific libraries and collections, and the establishment of scientific research stations in such places as the Galapagos Islands, New Caledonia, Hollandia, and the Philippines.

The Conference also specifically recommended to the Research Council the establishment of a Pacific Science Board to advise and assist all American scientists interested in the Pacific.

The closing session of the Conference consisted of a round-table discussion of the implementation of some of the recommendations of the Conference. Liaison members from government agencies, foundation representatives, and various scientists made suggestions as to ways and means of actualizing the proposals in the official recommendations. Throughout the Conference there was a general sense of the importance of the Pacific and the future role to be played by American science in that area.

A complete report of the statements by the chairman of the National Research Council and government liaison representatives at the opening session, as well as the discussion at the closing or implementation session, and the complete and final recommendations of the Conference to the National Research Council are contained in the *Proceedings of the Pacific Science Conference* (Bull. 114, 1946. Pp. 79. $.50), which may be obtained from the Publications Office, National Research Council, 2101 Constitution Avenue, Washington 25, D. C.—*Harold J. Coolidge* (Museum of Comparative Zoology, Harvard University).

The Sixth International Congress for Applied Mechanics met at the Sorbonne in Paris, France, on 22–29 September, immediately following the International Technical Congress on 16–21 September. Clarence E. Davies, secretary of the American Society of Mechanical Engineers, arranged for American participation in both meetings. About 25 papers were presented by Americans, many of the authors attending in person.

The American committee, under the chairmanship of Dr. Davis, included: Thomas B. Drew, Columbia University (chemical engineers); Everett S. Lee, General Electric Company (electrical engineers); Vern O. Knudson, University of California (physicists); J. L. Synge, The Ohio State University (mathematics society); F. B. Farquharson, University of Washington (civil engineers); H. Poritsky, General Electric Company, and J. P. den Hartog, Massachusetts Institute of Technology (mechanical engineers); Elmer A. Sperry, Jr., Sperry Products, Inc. (aeronautical sciences); H. C. Dickenson, National Bureau of Standards, and Stephen J. Zand, Sperry Gyroscope (automotive engineers).

The Association of American State Geologists celebrated its 40th anniversary with a conference and field session held in the Black Hills of South Dakota during the last week in August. Arthur Bevan, of Virginia, was appointed chairman of the committee for the occasion, and Edgar P. Rothrock, South Dakota, and Horace D. Thomas, Wyoming, had general charge, planning the itineraries and lecturing on geology. Four days were spent in intensive field trips

covering the major geological features of the region in two states. Some 20 states were represented, while guests included members of the geologists' families and staffs, together with invited lecturers.

The production of electrical power from nuclear energy may become an important factor in the operation of public utilities, Harry A. Winne, vice-president of General Electric Company, Schenectady, reported to the American Society of Mechanical Engineers at the luncheon session of its fall meeting in Boston on 3 October. However, such industrial use of nuclear energy will come gradually, possibly in 20 or 30 years, and will "supplement and complement our present power sources, not replace them," he said.

Speaking on "Power—Where Do We Go From Here?" Mr. Winne stated that other possibilities for the utilities industry will be even higher steam pressures and temperatures than those now in use; further developments in the mercury vapor process; and the use of the stationary gas turbine. Reviewing the tremendous advances made in the generation of power from fuel, particularly that for public utilities, he traced the increased efficiency and decreased coal consumption through the use of higher steam pressures and temperatures. "We are urging our metallurgists to find materials suitable for continuous operation at 1,200° F. and higher; we are asking our designers to produce machines to operate at these temperatures and still have the almost perfect reliability demanded by all utilities."

"Nuclear energy is essentially a source of heat," he said. "We can foresee no way of converting it directly into usable electrical power in significant quantities. So, we may look for the atomic power plant of the future to consist of the nuclear reactor, or so-called "pile," in which heat will be generated by fission and transferred through suitable means, probably with an intermediate transfer, to some more or less conventional power-generating unit, such as a steam turbine, a gas turbine, or a unit utilizing the vapor of mercury or some other substance. As many of you know, such a plant is already being engineered at Clinton Laboratories, Oak Ridge, Tennessee (see *Science*, 1946, **103**, 532). But this is simply a pilot plant, a developmental installation, really practically a laboratory experiment. Many, many technical problems remain to be solved, but I feel sure they can be, and will be solved.

"Personally, I believe that in the course of time, production of electrical power from atomic energy will become an important factor. But in my estimation that time is considerably more than 10 years away—quite possibly two or three decades. And the introduction of atomic power into our economy will, I believe, be very gradual and not at all upsetting to our present utility industry. I look for atomic energy to supplement and complement our present power sources—not to replace them."

The College of Engineering, University of Denver, has announced the following appointments to its staff: John W. Greene, formerly at the Mellon Institute and at Kansas State College, head of the Department of Chemical Engineering; James R. Macdonald, formerly of the University of West Virginia, associate professor in the same Department; Martin P. Capp, formerly at the Colorado School of Mines, head of the Department of Civil Engineering; Benjamin A. Fisher, formerly at Oklahoma A and M College, professor of electrical engineering; and Frederic S. Fry, formerly with the Bureau of Agricultural Economics and the Bureau of Reclamation, assistant professor of mechanical engineering.

A broadened agricultural research program has been authorized under the Flannagan-Hope Act, signed on 14 August by the President, according to the U. S. Department of Agriculture. A total of $9,500,000 has been authorized to be appropriated in the 1947 fiscal year for agricultural research and marketing services with special emphasis on utilization of farm products, and the marketing and transportation of farm products and cooperative production research. The principal objective of the legislation is to give agriculture parity with industry in the field of research.

A feature of the legislation is its emphasis on research and services to improve the marketing, handling, storage, processing, transportation, and distribution of agricultural products. Permitted fields of research include improved methods of production, problems of human nutrition, discovery of new and useful crops, expanded uses for farm products, and conservation and development of land, forest, and water resources for agricultural purposes.

A major share of the expanded research work will be done by State agricultural experiment stations as provided in the Bankhead-Jones Act. The new measure gives a formula for dividing the annual appropriation among states, territories, and Puerto Rico.

The Dohme Lectures are to be given by N. Hamilton Fairley, Wellcome professor of tropical medicine, University of London, at The Johns Hopkins University School of Medicine, Baltimore, Maryland, on 20–22 November. Dr. Fairley's subject will be "Chemotherapy of Malaria."

The Brooklyn Botanic Garden announces the following appointments, which became effective on 1

October: L. M. Black, formerly of the Rockefeller Institute for Medical Research, Princeton, New Jersey, will succeed George M. Reed (retired) as curator of plant pathology. A. Gawadi, formerly associate professor of botany at Alexandria University, Egypt, has been awarded a fellowship at the Garden for research studies on growth. The latter is a graduate of the University of Cairo and received his doctorate from the Botany School, Cambridge University, England.

Meetings

The Animal Vitamin Research Council will hold its annual meeting at the Shoreham Hotel, Washington, D. C., on 17 October. The Council was organized in 1940 for the purpose of stimulating research and promoting collaborative studies of vitamin assay methods. Harry W. Titus is chairman of the Council; A. Black, treasurer; and Bernard L. Oser, secretary.

The 38th Annual Meeting of the American Phytopathological Society will be held at the Netherland Plaza Hotel, Cincinnati, Ohio, on 28–30 December 1946.

The American Association of Petroleum Geologists will hold its midyear meeting in Biloxi, Mississippi, on 24–25 October, with headquarters at the Buena Vista Hotel. Morning and afternoon technical sessions will be devoted to the presentation of papers discussing the stratigraphy and geology of southeastern United States and the geology of typical oil fields in the area.

Elections

The Pittsburgh Geological Society at its recent meeting elected the following officers for 1946–47: Hugh R. Brankstone, Gulf Oil Corporation, president; Shailer S. Philbrick, vice-president; W. B. Robinson, secretary; C. H. Feldmiller, treasurer; and Geo. C. Grow, Jr., Raymond E. Birch, Daniel A. Busch, Richard M. Foose, John T. Galey, J. LeRoy Kay, and James H. C. Martens, councillors.

At the meeting of the American Board of Pathology, held on 5 July, A. H. Sanford, Frank Hartman, Frederick Lamb, and J. J. Moore retired after 12 years service on the Board, which includes Shields Warren, N. C. Foot, R. P. Custer, William Sunderman, Paul Cannon, James McNaught, and Robert A. Moore. New members of the Board are Joseph A. Kasper, James Kernohan, and Edwin Schultz. The following officers were elected for the coming year: N. C. Foot, president; William Sunderman, vice-president; and Robert A. Moore, secretary-treasurer.

The next examination will probably be held in Philadelphia about 1 June 1947. All inquiries should be sent to Dr. Robert A. Moore, Washington University School of Medicine, St. Louis 10, Missouri.

A. T. Poffenberger, professor of psychology at Columbia University, was elected chairman of the Social Science Research Council on 12 September.

The Louisville Physics Society ended its first year with a dinner meeting on 6 June at which D. M. Bennett, retiring president, spoke on "The Future of Physics." At this meeting Peter L. Vissat was installed as president, and H. T. Smyth, as secretary-treasurer.

The American Association for the Study of Sterility recently elected Walter W. Williams, Springfield, Massachusetts, as president, and John O. Haman, San Francisco, as secretary-treasurer. Honorary members elected were: Carl G. Hartman, University of Illinois; George Papanicolaou, Cornell University; and Lane-Roberts, England.

The American Society of Ichthyologists and Herpetologists held its first postwar meeting in Pittsburgh on 16–18 April. Officers elected for 1946–47 are: John Treadwell Nichols, American Museum of Natural History, and Helen T. Gaige, University of Michigan, honorary presidents; Carl L. Hubbs, Scripps Institution of Oceanography, president; Roger Conant, Philadelphia Zoological Garden, Milton B. Trautman, Franz Theodore Stone Laboratory, and Arnold B. Grobman, University of Florida, vice-presidents; Arthur W. Henn, Carnegie Museum, treasurer; M. Graham Netting, Carnegie Museum, Pittsburgh, secretary; Helen T. Gaige, editor-in-chief; Reeve M. Bailey and Norman Hartweg, University of Michigan, managing editors; Lionel A. Walford, Fish and Wildlife Service, Washington, D. C., ichthyological editor; Karl P. Schmidt, Chicago Natural History Museum, herpetological editor; and Walter L. Necker, 6843 Hobart Avenue, Chicago, historian.

At the Ninth Meeting of the Society for Research on Meteorites, held at the Arizona State College, Flagstaff, and Meteorite Crater, Arizona, on 9–10 September, the following members of the Council were elected for the 1946–50 term: Arthur S. King, Mount Wilson Observatory, president; F. R. Moulton, Washington, D. C., Charles P. Olivier, Upper Darby, Pennsylvania, and L. J. Spencer, London, England, vice-presidents; Oscar E. Monnig, 1010 Morningside Drive, Fort Worth, Texas, secretary; L. F. Brady, Museum of Northern Arizona, Flagstaff, treasurer; and Frederick C. Leonard, Los Angeles, editor. The new councilors are: John Davis Buddhue, C. H. Cleminshaw, Lincoln La Paz, Earle G. Linsley,

Howard A. Meyerhoff, Stuart H. Perry, J. Hugh Pruett, and Fred L. Whipple.

Twenty-four papers were presented at the meeting, at the conclusion of which the name of the Society was officially changed from "The Society for Research on Meteorites" to "The Meteoritical Society."

Recent Deaths

Walter G. Karr, 53, of the University of Pennsylvania Graduate School of Medicine and director of the research laboratories of Smith, Kline & French, died on 16 September in Newport, Pennsylvania.

Harold John Edward Peake, 78, a fellow of the Society of Antiquaries, died at his home in Boxford, England, on 22 September. He was best known to United States readers for two books, *The Bronze Age* and *The Celtic World,* written in collaboration with Prof. H. J. Fleure. Dr. Peake was past-president of the Anthropological Section of the British Association for the Advancement of Science and a former Huxley Memorial Lecturer and Medalist.

August Koch, 72, retired chief horticulturist, Chicago Park District, died in Chicago on 23 September. He was formerly on the staff of the Missouri Botanical Gardens, St. Louis.

Gilbert E. Seil, 57, formerly on the Technologic Committee on Manganese, National Research Council, died in Philadelphia on 11 September.

Zoological Station at Naples

The vicissitudes of the Zoological Station during the last years of the war have been described by Giuseppe Montalenti in *Pubblicazioni della Stazione Zoologica di Napoli* (1946, **20**, 75). The transfer of the library to Pontelandolfo (in the province of Benevento) was accomplished in the early summer of 1943, in order to withdraw it from the threat of air raids.

On 4 August 1943 the Dohrn's house in Via Crispi was destroyed by a bomb. After the armistice on 8 September, the Germans took military command of the city of Naples and, 16 days later, ordered the evacuation of the zone of the city in which the Aquarium is located. The Institute was left by the personnel on 25 September; then, the German troops having retired, the Institute was reoccupied by the staff on 30 September and found almost intact, even the boats being undamaged. The lack of electric current for 36 hours and the consequent stoppage of the pumps was not fatal to the majority of the Aquarium animals, only a few being asphyxiated. A Diesel oil motor was put into operation to run the pumps, and the Aquarium was thus saved.

The park, Villa Comunale, in which the Aquarium is located was then occupied by some units of the American Army. Personal passes were granted to the Zoological Station staff to enable them to reach the Institute. Due to the highly cooperative spirit of the American officers of the occupying units, the life of the laboratory was allowed to continue almost without interference, in the midst of military business. The Allied Military Government granted substantial financial help, anticipating funds on account to the Italian Government, in order to pay salaries and to cover current expenses. The Aquarium was opened to Allied troops as early as 10 December 1943, the income derived therefrom being added to the regular funds. During the first months of 1944 a grant of 1,000 pounds was received from the Royal Society in London.

The Villa was left by the occupying units on 1 May 1944, and the activity of the Station became almost normal under the leadership of the director, Prof. Dohrn (who returned from Sorrento, where he had found accommodation after the loss of his home), assisted by the constant cooperation of the Allied Military Authorities.

The library escaped destruction and heavy losses, although the very front line passed through Pontelandolfo in October 1943. It was taken back to Naples and put in order in the early summer of 1944.

After the liberation of Rome on 4 June 1944, contacts were made with the Italian Ministry of Public Instruction, and the Italian National Research Council. Both bodies helped the Zoological Station very consistently. The latter founded here a Center for Biological Studies, under the directorship of G. Reverberi, for the purpose of granting fellowships to biological students. Later on, Switzerland, Sweden, England, and the United States renewed some of the "working tables" they used to rent before the war, thus starting again the international intercourse which is one of the most outstanding features of the Station.

The activity of the Institute itself, which fortunately came through the war almost intact, is now gradually returning to normal. Although financial problems are still of the utmost gravity because of the currency devaluation and the uncertain economic conditions of the whole world, Dr. Montalenti expresses the hope that in a reasonably short time the Station will fully resume its function in the development of biological sciences, in an atmosphere of peace and international scientific collaboration. He emphasizes the importance of the fact that these old laboratories and the famous library escaped destruction, and considers this a favorable omen for the future of the Institute.—*Camillo Artom* (Wake Forest College, Winston-Salem, North Carolina).

Letters to the Editor

Use of Perchloric Acid as an Oxidizing Agent

Commercial perchloric acid of 60 to 70 per cent concentration has been recommended by several investigators for the destruction of organic matter in various analytical procedures. We have been using it for the estimation of small amounts of iodine and phosphorus in plant material, both by itself and with sulfuric and nitric acids. Recently we have had a violent explosion for no apparent reason after the oxidation with dried potatoes had been completed and when the mixture was cooling spontaneously. This occurred in an enclosed system in a mixture of sulfuric and perchloric acids in a ratio of 3:1. A silicone grease had been used as lubricant on the ground-glass joints of the apparatus.

A review of the literature reveals that several explosions have been reported with perchloric acid. Nicholson and Reedy (*J. Amer. chem. Soc.*, 1935, **57**, 817–818) found that it reacts explosively with metallic bismuth. Serious explosions in steel plants are described by Gabiersch (*Stahl Eisen*, 1943, **63**, 226) and Dietz (*Angew. Chem.*, 1939, **52**, 616–618). Deiss (*Anal. Chem.*, 1936, 107, 8–14) mentions the formation of an unstable ester in alcohol as a possible explanation of his explosion in determining potassium. Kahane (*Compt. rend.*, 1931, 193, 1018–1020; *Z. anal. Chem.*, 1937, **111**, 14–17), working with organic material, states that perchloric acid is safe provided that sufficient amounts are used or that it is diluted with sulfuric acid. A preliminary attack with nitric acid to remove all easily oxidizable substances is recommended. Balks and Wehrmann (*Bodenk. Pflanzenernähr.*, 1938, **11**, 253–254) analyzed samples of liver with perchloric acid without incident but had a violent explosion when the same method was applied to fish muscle.

This letter is written as a warning that suitable precautions should be taken when perchloric acid is used as an oxidizing agent. It is also hoped that information will be forthcoming to establish the conditions of explosion.

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Safety and the Direction of Rotation of the Automobile Engine

The crankshaft of the usual automobile of today turns about the long axis of the chassis, and the car is driven, keeping to the right, on roads with a slight crown (central elevation for providing drainage). What are the consequences of these facts?

The result of driving to the right is that normally the automobile rides with its left wheels higher than its right. Going around a curve at a particular speed is therefore safer when turning to the right than to the left. In the first instance the car is on a road banked to aid the turn, while in the second instance the banking (the effect of the crown of the road) is the opposite, its tendency being to accentuate the effect of centrifugal force by tilting the car to the outside of the curve so that a skid off the road on a left turn becomes more likely. If the road is perfectly banked, of course this analysis does not apply.

What is the relationship of the rotation of the motor to this problem? Newton's law—action and reaction are equal and opposite in direction—can immediately be applied. Since the rear wheels are forced by the motor to rotate forward, the chassis must be pulled by the motor so as to make it tend to "rise upon its haunches" about the rear axle. This can be seen experimentally by suddenly accelerating the car from rest, when it will be noted from the driver's seat that the radiator rises. This tendency is all to the good when the automobile is negotiating a turn in either direction, since it increases the effective weight on the rear wheels, where skidding is more likely, and so reduces their liability to skid.

Newton's law also tells us that, corresponding to the longitudinal rotation of the crankshaft and torque tube, there is a tendency for the chassis to twist in the opposite direction. This can be seen by simply racing the motor in neutral with the car stationary; the hood will dip to the right, as though someone had stepped onto the running board on the right-hand side. If the motor were to turn clockwise (as seen from the driver's seat), which is opposite to the direction of rotation of *all* present-day American automobiles, the motor hood would be seen to dip toward the left. The direction of motor rotation therefore determines whether the car leans as though weight were shifted to the right or to the left side. Leaning to the right side (counterclockwise motor rotation) will increase safety on right-hand turns but reduce safety on left-hand turns; leaning to the left side (clockwise motor rotation) will reduce safety on right-hand turns but increase safety on left-hand turns. Since the left-hand turn is intrinsically more dangerous than the right-hand one, the safer direction for motor rotation is clockwise, which will reduce the danger of the left-hand turn. A shift from our present-day counterclockwise rotating motors to clockwise ones would tend to mitigate the untoward banking effect caused by the crown of our roads, thus achieving a net gain in safety.

Another more minor result of the longitudinal placement of the motor is its gyroscopic activity. Analysis of the vectors of rotation shows that with the proposed clockwise rotation the rear wheels are pressed down harder on a left-hand than on a right-hand turn, the opposite of the present situation. Thus, the safety factor contributed by clockwise motor rotation is further enhanced by gyroscopic effects. It is only in countries like England, where traffic keeps to the left, that present-day motors turn in the direction of choice.

Evolution occurs piecemeal in industry, as it does in biology. The right-handed person naturally cranks an automobile in the direction now standard because engines

were originally made to be cranked by hand. Today our high-compression powerful motors cannot be cranked by hand, but, like the vermiform appendix in man, the archaic counterclockwise direction of rotation persists. With the resumption of automobile manufacture for civilian use, consideration should be given to making our new peacetime engines turn in the safer, clockwise direction. The cost is negligible, since the change is only a minor engineering one. The gain, while it may not bulk large in terms of the per cent change in the accident rate, is desirable to the individuals who may thereby be spared.

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The Etymology of "Fission"

Etymological matters should be left to experts; however, as this is not done in *Science*, I should like to add a comment at the risk of seeming pedantic. In regard to the English noun *fission*, from the Latin noun *fissio, fissionis*, a splitting, I think the verb should also be *fission*. Cf. *caution*, which is both noun and verb, from *cautio, cautionis*; and *petition*, both noun and verb, from *petito, petitionis*.

Then we get the accepted adjective *fissile* (pronounced without an aspirate and dated 1661 by the Oxford Dictionary) and the new and proper adjective *fissionable*. The two are doublets, but, if *fissile* has acquired a special connotation, as J. D. Buddhue suggests (*Science*, 1946, 104, 301), then *fissionable* is left for more general use.

The language already has *fissive* in it, meaning pertaining to fission, and many words formed on the *fissi-* stem: *fissiparous, fissiped*. Perhaps we are now ready for some more of these words.

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Pleistocene Fossils in Eocene Rock From New Jersey

For the past few years the writer has been collecting pieces of greenish and brownish stone washed up on the Atlantic beach between Belmar and Long Branch, New Jersey. Many of these pieces of rock are highly glauconitic and bear a close resemblance to the "greensand" of the Shark River and Manasquan formations of Eocene age which outcrop a few miles inland from the coast. That this rock is of Eocene age is confirmed by the presence of the typical Shark River fossil (*Venericardia perantiqua* Conrad) and the fish jaw (*Nodidanion howelli* Reed), the latter recently described from one of these stones (*Acad. nat. Sci. Phila. Not. Nat. 172*, 1946). Some of the brown stone contained typical Vincentown (Eocene) Bryozoa.

It seems logical to suppose that these Eocene formations, especially the Shark River and the Manasquan, continue eastward from land outcrops and are exposed on the sea bottom off the New Jersey coast.

It was further observed that these pieces of rock had been bored by pelecypods. At first it was thought that these were also of Eocene age, but upon identification they proved to be *Pholas truncata* Say, *Zirphaea crispata* Linné, and *Petricola pholadiformis* Lamarck—all characteristic species of the Pleistocene and Recent and not known from the Eocene. Some of the shells are imbedded firmly in the rock, while others are in unconsolidated sand within the harder rock.

Probably the Eocene rock was exposed on the sea bottom during Pleistocene or Recent times. During that time it was bored by these pelecypods, the holes then becoming filled with unconsolidated sand, partly derived from the disintegrated Eocene greensand rock. In this sand were contemporary (Pleistocene or Recent) shells. The lime from these shells gradually acted as a cementing agent, causing the holes to become completely filled, so that it is frequently impossible to recognize the outline of the original hole, although many transitional stages have been noted.

Among the Pleistocene (or Recent) species found in the fillings of these borings are *Nucula proxima* Say, *Nassarius trivittatus* Say, and *Mactra soladissima* Dillwyn. Petrified wood, thoroughly riddled by *Teredo*, was also noted.

This seeming mixture of faunas of two ages in a single deposit is not uncommon and frequently causes headaches to stratigraphers. The present mixture would, however, appear to be easily explained in the manner indicated above.

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"Container-Dent Sensitivity" of Explosives

When explosions result from rough handling of bomb-type ammunition, they generally must be ascribed to accidental fuse action because, with fuses generally present, alternative explanations appear less reasonable. But during the war there have been some explosions of items of bomb-type ammunition where (with partial detonations) fuses were recovered intact, and other cases where bomb-type ammunition items were exploded without any fuses in them. The impacts which resulted in these explosions were caused by relatively light bumping or by the items falling from heights ranging from 4 inches up to 4 or 5 feet; and they were too slight to have caused rupture or more than mere dents.

This phenomenon, now called "container-dent sensitivity" differs essentially from "bullet sensitivity" or from "fragment sensitivity," which produce detonations of explosives in thin metal containers when the latter are penetrated by bullets or fragments at high velocities on the order of 2,000 feet per second or more but are only ignited, or are unaffected, at much lower, though still "penetrative," velocities.

Also, this phenomenon is by no means the same as that involved where an even greater height of fall of a small weight is used to explode a few milligrams of *bare* explosives in conventional "impact sensitivity" tests. Its existence seems, in fact, not implied by results of usual explosive sensitivity tests, and it appears to have had little or no important mention in the literature of explosives.

Dents on U. S. bomb-type ammunition caused by impacts at least as severe as impacts causing these occa-

sional explosions probably occur by the million, so that explosions from denting impacts are fortunately of extremely low frequency. With U. S. bomb-type ammunition during the war there have been only about 20 incidents probably ascribable to this cause; but they have included particularly bad ones which, by one rough estimate, involved total property losses of many millions of dollars, as well as thousands of deaths and injuries.

Such occurrences seem more frequent with the more sensitive explosives; but TNT and amatol, as well as RDX explosives, have all been involved. Very thin-walled containers, such as those of depth bombs and torpedo war heads, appear relatively more susceptible. One may surmise that a trivial local ignition is produced by certain unidentified critical conditions of denting, and that burning to partial or complete detonation is peculiarly favored by confinement afforded by the dented, but unbroken, container.

Adequate understanding of the mechanism of this phenomenon apparently requires further fundamental research, which possibly may result from more widely disseminated knowledge of the existence of "container-dent sensitivity" and from fuller appreciation of its practical importance.

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Book Reviews

Mathematical theory of elasticity. **I. S. Sokolnikoff (with the collaboration of R. D. Specht). New York: McGraw-Hill, 1946. Pp. ix + 367. (Illustrated.) $4.50.**

Although the scientific literature now contains a considerable number of treatises and textbooks on the theory of elasticity, this book will be welcomed for its mathematical rigor and its stimulating and refreshing approach to the subject. Rather than following the more conventional procedure of developing the fundamental stress and strain concepts from the coordinate point of view, the first two chapters make free use of tensor analysis. While thus achieving abbreviated expressions for strain and stress combinations, it has the additional advantage of giving the student a more general conception of the physical meaning of these quantities. The notation employed for strain is quite similar in most respects to that in common use in this country. The stress notation, however, differs from current American practice by use of the Greek letter τ with proper subscripts for both normal and shearing stresses. It is more common in this country to use the Greek letter σ for normal stresses and τ for shearing stresses. This, however, should cause no appreciable difficulty.

The real advantage of adopting the tensor notation becomes more evident from the discussion of the stress-strain relations in Chapter 3. Hooke's generalized law in tensor notation is expressed by one equation, whereas in coordinate form six equations are required. Similarly, the six compatibility equations in terms of stress are written as one equation in tensor form. The same chapter contains a discussion of equilibrium, strain energy, boundary-value problems, and St. Venant's principle.

The discussion of these essential fundamental concepts is accomplished in less than 100 pages. Although tensor notation is used for the most part, the equivalent coordinate expressions are usually also listed. The remaining portion of the book, comprising applications of the theory, abandons the tensor notation where, as expressed by the author, "the economy of thought achieved by tensor symbolism is in some doubt," and the usual scalar methods adopted. For those familiar with the basic relationships in the theory of elasticity, the remaining portion of the book should be easy to follow even if they are unfamiliar with tensor notation.

Chapter 4, 160 pages in length, gives an up-to-date and comprehensive treatment of the extension, torsion, and flexure of homogeneous beams. The attention of American scientists and engineers is also called to various recent publications in this field by a number of Russian authors, and several sections of the chapter follow the prize-winning work of N. I. Muschelišvili as well as the original contributions of the author. The use of conformal mapping, complex variables, the formulas of Schwartz and Poisson, and membrane analogies is discussed.

The last chapter of the book is devoted to variational methods, including the theorems of minimum potential energy, work, and reciprocity. Galerkin's method, the Rayleigh-Ritz method, and the method of finite differences are also included. In this chapter the relaxation method of Southwell is only mentioned. Since the latter procedure has proved to be of great use in elasticity problems, a treatment of this method would have been a valuable addition.

A very worth-while feature in the nature of a summary of formulas is contained in the Appendix.

This book is a welcome addition to the literature on the subject and will be of great use to students and engineers working in this field. It is mentioned in the Preface that a companion volume dealing with two-dimensional problems of elasticity, plates, and shells may be forthcoming. It is hoped that the author will be encouraged to prepare this supplementary treatment of the present excellent book.

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